

I claim the following:

1. Apparatus for excision of a sub-cutaneous target tissue mass through a cutaneous incision smaller than maximum transverse dimension of the tissue mass excised, comprising:
  - a. an axially elongated housing;
  - b. tissue piercing means slidably resident within said housing;
  - c. means connected to said elongated housing and being resiliently radially expandable relative thereto for cutting a conical swath having radius greater than maximum transverse dimension of said elongated housing and greater than maximum transverse cross-sectional dimension of said target tissue mass to separate said target tissue mass from surrounding tissue for excision thereof through said incision.
2. Apparatus of claim 1 further comprising:
  - a. expandable means within said elongated housing, axially slidably advanceable and radially expandable through said conical swath to collectably bag said target tissue mass for aseptic removal in an axial direction via said elongated housing through said incision.
3. Apparatus of claim 2 further comprising:
  - a. a sheath axially slidably resident within and concentric with said elongated housing for applying radially inward force on said target tissue mass bagging means and any target tissue mass contained therewithin prior to removal

thereof from said subcutaneous tissue via said housing.

4. Apparatus of claim 3 further comprising drawstring means for closing said bag means about any target tissue mass contained therewithin by radially inward movement of a circular periphery of said bag means.
5. Apparatus of claim 1 wherein at least said tissue piercing means portion of said apparatus is detectable fluoroscopically.
6. Apparatus of claim 1 wherein at least said tissue piercing means portion of said apparatus is detectable ultrasonically.
7. Apparatus of claim 1 wherein at least said tissue piercing means portion of said apparatus is detectable using mammographic x-ray.
8. Apparatus of claim 1 wherein at least said tissue piercing means portion of said apparatus is detectable tomographically.
9. Apparatus of claim 1 further comprising
  - a. means for electrically heating said cutting means for cauterizingly cutting to detach the target tissue mass from surrounding tissue.
10. Apparatus of claim 9 further comprising
  - a. means for electrically energizing said cutting means for coagulating tissue around said target tissue mass during cutting.
11. Apparatus of claim 1 wherein said cutting means comprises a laser.
12. Apparatus of claim 1 wherein said cutting means comprises

wire.

13. A method for excision of a sub-cutaneous target tissue mass through a cutaneous incision smaller than maximum transverse dimension of the tissue mass excised, comprising:
  - a. advancing tissue piercing means towards a patient to create an incision in the patients's skin;
  - b. slidably advancing cutting means through said incision and into sub-cutaneous tissue until in position to radially expand and cut a conical swath around said target tissue mass larger than said incision;
  - c. cutting a conical swath around said target tissue mass thereby separating said target tissue mass from said surrounding tissue;
  - d. slidably advancing flexible aseptic containment means over said separated target tissue mass to a position of closure around said target tissue mass;
  - e. withdrawing said flexible aseptic containment means with said target tissue mass aseptically contained therewithin through said incision.
14. The method of claim 13 further comprising radially inwardly collapsing said cutting means after cutting said swath.
15. The method of claim 13 further comprising fluoroscopically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut said swath around said target tissue mass.
16. The method of claim 13 further comprising ultrasonographically

guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut said swath around said target tissue mass.

17. The method of claim 13 further comprising x-ray mammographically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut said swath around said target tissue mass.
18. The method of claim 13 further comprising computer-aided tomographically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut said swath around said target tissue mass.
19. The method of claim 13 wherein said cutting means is a laser.
20. The method of claim 13 wherein said cutting means includes a blade.
21. The method of claim 13 wherein said cutting means includes a cutting wire.
22. The method of claim 13 wherein said cutting means is cryogenic.
23. The method of claim 13 wherein said cutting means utilizes radiofrequency wave energy.
24. The method of claim 13 wherein said cutting means utilizes chemical ablation.
25. Apparatus for excision of a sub-cutaneous target tissue mass

through a cutaneous incision smaller than maximum transverse dimension of the tissue mass excised, comprising:

- a. an axially elongated member including cutaneous tissue piercing means at one end;
- b. means connected to said elongated member and being radially expandable relative thereto for cutting a circumferential swath of radius greater than maximum transverse dimension of said elongated member and greater than maximum transverse cross-sectional dimension of said target tissue mass to separate said target tissue mass from surrounding tissue for excision thereof through said incision.

26. Apparatus of claim 25 further comprising:

- a. expandable aseptic shield means concentric with said elongated member, axially slidably advanceable over said cutting means when in the radially expanded configuration to collectably bag said target tissue mass detached from a patient by said circumferential swath cutting for aseptic removal in an axial direction together with said elongated member through said incision resulting from entry of said cutaneous tissue piercing means.

27. Apparatus of claim 26 wherein said aseptic shield means is advanceable towards said tissue piercing means.

28. Apparatus of claim 26 further comprising:

- a. a sheath axially slidably concentric with said elongated member, connected to first ends of said cutting means for

expanding said cutting means from generally linear and axial orientation to a curved basket-like orientation by axial movement relative to said elongated member.

29. Apparatus of claim 26 wherein second ends of said cutting means are connected to said elongated means proximate said tissue piercing means.
30. Apparatus of claim 26 wherein said aseptic shield means is a flexible membrane.
31. Apparatus of claim 26 further comprising drawstring means for closing said shield about said cutting means and any target tissue mass contained therewithin.
32. Apparatus of claim 25 wherein at least said tissue piercing means portion of said apparatus is detectable fluoroscopically.
33. Apparatus of claim 25 wherein at least said tissue piercing means portion of said apparatus is detectable ultrasonically.
34. Apparatus of claim 25 wherein at least said tissue piercing means portion of said apparatus is detectable using mammographic x-ray.
35. Apparatus of claim 25 wherein at least said tissue piercing means portion of said apparatus is detectable tomographically.
36. Apparatus of claim 25 further comprising
  - a. means for electrically heating said cutting means for cauterizingly cutting to detach the target tissue mass from surrounding tissue.
37. Apparatus of claim 36 further comprising

- a. means for electrically energizing said cutting means for coagulating tissue around said target tissue mass during cutting.

38. Apparatus of claim 25 further comprising

- a. means for rotating said cutting means.

39. Apparatus of claim 25 wherein said cutting means comprises at least one blade.

40. Apparatus of claim 25 wherein said cutting means comprises a laser.

41. Apparatus of claim 25 wherein said cutting means comprises wire.

42. A method for excision of a sub-cutaneous target tissue mass through a cutaneous incision smaller than maximum transverse dimension of the tissue mass excised, comprising:

- a. advancing tissue piercing means towards a patient to create an incision in the patients's skin;
- b. slidably advancing cutting means through said incision and into sub-cutaneous tissue until in position to radially expand said cutting means and cut a circumferential swath around said target tissue mass larger than said incision;
- c. cutting a circumferential swath around said target tissue mass thereby separating said target tissue mass from said surrounding tissue;
- d. slidably advancing flexible aseptic containment means over said separated target tissue mass to a position of

closure around said target tissue mass;

- e. withdrawing said flexible aseptic containment means with said target tissue mass aseptically contained therewithin through said incision.

43. The method of claim 42 further comprising collapsing said cutting means after cutting said swath.

44. The method of claim 42 further comprising fluoroscopically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut a circumferential swath around said target tissue mass.

45. The method of claim 42 further comprising ultrasonographically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut a circumferential swath around said target tissue mass.

46. The method of claim 42 further comprising x-ray mammographically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut a circumferential swath around said target tissue mass.

47. The method of claim 42 further comprising computer-aided tomographically guiding said tissue piercing means through said incision and into sub-cutaneous tissue until said cutting means is in position to cut a circumferential swath around said target tissue mass.



48. The method of claim 42 wherein said cutting means is a laser.
49. The method of claim 42 wherein said cutting means includes a blade.
50. The method of claim 42 wherein said cutting means includes a cutting wire.
51. The method of claim 42 wherein said cutting means is cryogenic.
52. The method of claim 42 wherein said cutting means utilizes radiofrequency wave energy.
53. The method of claim 42 wherein said cutting means utilizes chemical ablation.
54. Apparatus for excision of a sub-cutaneous target tissue mass through a cutaneous incision smaller than maximum transverse dimension of the tissue mass excised, comprising:
- a. an axially elongated containment sheath having a resiliently expandable portion at one end thereof;
  - b. means insertable through said containment sheath for making said cutaneous incision;
  - c. a plurality of axially elongated support members insertable through said incision and said containment sheath and said incision into sub-cutaneous tissue, said support members being connected at their proximate ends, distal ends of said support members being unconnected to define a conical penumbra within said subcutaneous tissue;
  - d. means for resiliently expanding said support members into

said conical penumbra-defining orientation;

- e. a support catheter resident within and insertable through said containment sheath;
- f. a tissue cutting wire loop slidable<sup>y</sup> resident within said support catheter in said containment sheath adapted for gradual exit from said support catheter to axially circumferentially traverse the slant surface of said conical penumbra;
- g. a tissue containment bag insertable through said containment sheath and along said support members to reach the base of said conical penumbra, said bag including:
  - i. at least one drawstring threaded through the periphery of said bag at said conical penumbra for closing said bag about resected target tissue.

55. A method for excision of a sub-cutaneous target tissue mass through a cutaneous incision smaller than maximum transverse dimension of the tissue mass excised, comprising:

- a. advancing tissue piercing means through a containment sheath having an expandable portion towards a patient to create an incision in the patient's skin;
- b. slidably advancing support members through said incision and said containment sheath into sub-cutaneous tissue until the target tissue mass is within a conical penumbra defined by said support members;
- c. simultaneously:

- Patented
- i. axially advancing a tissue cutting loop of hot wire through a support catheter in said containment sheath respecting said cone circumferentially around the slant surface of said conical penumbra; while
  - ii. advancing additional loop length out of said catheter within said containment sheath to provide sufficient length for said loop to extend in circular fashion around the circumference of said cone on said slant surface parallel to the cone base; while
  - iii. advancing said support catheter through said containment sheath along the slant surface of said conical penumbra to maintain the outlet of said support catheter via which said loop is advanced adjacent to said loop at any location along said slant surface of said cone;
- until said tissue cutting loop reaches the cone base;
- d. while maintaining said catheter outlet at said cone base drawing said wire into said catheter resident in said containment sheath to eliminate the loop and cut through tissue in the shape of a cone base;
  - e. withdrawing said catheter and the enclosed wire from the patient through said containment sheath;
  - f. sliding a tissue containment bag through said containment sheath and along said conical support to reach the base

of said cone;

- g. pulling <sup>AT LEAST ONCE</sup> drawstrings threaded through the periphery of said bag at said cone base through said containment sheath to close said bag about said previously resected specimen;
- h. pulling said bag with said resected specimen therewithin into said expandable portion of said containment sheath thereby causing said sheath to expand and compress said specimen within said bag to smaller size;
- i. continuing pulling said bag with said compressed specimen therewithin through the remainder of said containment sheath and out of said patient.